

Applicant(s): Jong-hyon Ahn
U.S. Serial No.: 09/879,556

REMARKS

Claims 1-4, 8 and 9 are objected to because of certain informalities/defects. The claims have been amended as suggested by the Examiner such that it is believed that the objections are overcome, and reconsideration of the objections to the claims is requested.

Claims 1-3, 8 and 9 are rejected under 35 U.S.C. §102(e) as being anticipated by Chopra (U.S. Patent Number 6,413,858). Claim 4 is rejected under 35 U.S.C. §103(a) as being unpatentable over Chopra in view of JP 11-317407 (JP '407) and/or Liaw, et al. (U.S. Patent Number 5,554,565). In view of the amendments to the claims and the following remarks, the rejections are respectfully traversed, and reconsideration of the rejections is requested.

In the applicant's invention, a trench is formed in an interlevel dielectric (ILD) film with a desired shape such that, when the trench is filled with conductive material, the resulting conductive line will have the desired shape. In the present invention, the desired shape of the conductive line is such that, in cross section, the conductive line has a lower portion that is wider than the upper portion, such that lifting of conductive line from the device is prevented. To form the conductive line, the trench is formed such that its sidewalls define the desired cross-sectional shape of the conductive line. That is, to achieve the multiple desired widths, the trench is formed in the ILD film such that its sidewalls define a lower portion of the trench having a first width and an upper portion of the trench having a second width, wherein the first lower width is wider than the second upper width.

The claims have been amended to clarify these features of the invention. That is, the claims are amended to specifically recite that the trench is formed such that its sidewalls in the ILD film define two different portions of the trench such that, in cross-section, the trench has a lower portion wider than its upper portion. It is believed that this clarifying claim language serves to distinguish the cited prior art references.

In Chopra, the opening 14 formed in the ILD 12 is rectangular in cross-section. The sidewalls of the trench do not define an upper and lower portion having different widths. The Examiner is referred to column 6 lines 26-28 of Chopra wherein it is stated that conventional photolithography techniques can be employed to define the via 14, and anisotropic etching (e.g., reactive ion etching) is preferred for producing vertical via sidewalls. Hence, the language

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recited in the amended claims explicitly and clearly distinguishes the structure taught by Chopra. Therefore, Chopra fails to teach or suggest the invention set forth in the amended claims. Accordingly, reconsideration of the rejection of claims 1-3, 8 and 9 under 35 U.S.C. § 102(e) based on Chopra is respectfully requested.

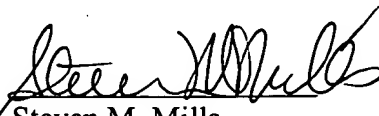
The Japanese reference JP '407 and Liaw, et al. both fail to teach or suggest the applicant's invention as set forth in the amended claims. Specifically, neither reference teaches or suggests the applicant's trench formed in an ILD film with sidewalls that define portions having different cross-sectional widths. Since none of Chopra, JP '407 and Liaw, et al. fail to teach or suggest the invention set forth in the amended claims, there is no combination of the references that would result in the teaching or suggestion of the invention set forth in the amended claims. Since none of the references, taken alone or in combination, teach or suggest the invention set forth in the amended claims, it is believed that the claims as amended are allowable over the cited prior art. Accordingly, reconsideration of the rejection of claim 4 under 35 U.S.C. § 103(a) based on Chopra, JP '407 and/or Liaw, et al. is respectfully requested.

Attached hereto is a marked-up version of the changes made to the claims by the current Amendment. The attached pages are captioned "Version with Markings to Show Changes Made."

In view of the amendments to the claims and the foregoing remarks, it is believed that, upon entry of this Amendment, all claims pending in the application will be in condition for allowance. Therefore, it is requested that this Amendment be entered and that the case be allowed and passed to issue. If a telephone conference will expedite prosecution of the application, the Examiner is invited to telephone the undersigned.

Respectfully submitted,

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Version with Markings to Show Changes Made

In the Claims

The claims have been amended as follows:

1. (Twice Amended) A metal interconnect [layer] structure for a semiconductor device, comprising:

[an elongate] a trench formed in an interlevel dielectric (ILD) film , the trench having sidewalls in the ILD film which are formed to define two cross-sectional portions of the trench, a lower portion of the trench having sidewalls which define a first cross-sectional width of the trench and an upper portion of the trench having sidewalls which define a second cross-sectional width of the trench, the first cross-sectional width of the lower portion of the trench being wider than the second cross-sectional width of the upper portion of the trench;

a conductive layer forming a conductive line in the [elongate] trench, the conductive line having, in cross-section, a first upper portion [having a first width] and a second lower portion under the first upper portion, the second lower portion [having a second width] being wider than the first [width] upper portion.

2. (Twice Amended) The metal interconnect [layer] structure of claim 1, wherein the metal interconnect layer comprises:

a barrier layer deposited along the bottom and side surfaces of the [elongate] trench; and wherein

the conductive layer is deposited over the barrier layer filling the trench.

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3. (Amended) The metal interconnect [layer] structure of claim 2, wherein the ILD film is formed of a single insulation layer with a material layer selected from the group consisting of undoped silicate glass (USG) layer, silicon oxide fluoride (SiOF) layer, tetraethylorthosilicate (TEOS) layer, spin-on glass (SOG) layer and borophosphosilicate glass (BPSG).

4. (Amended) The metal interconnect [layer] structure of claim 3, wherein the thickness of an upper portion of the ILD film [surrounding] abutting a portion of the trench with the upper width is in the range of 20-70% of the thickness of the entire ILD film.

8. (Amended) The metal interconnect [layer] structure of claim 2, wherein the barrier layer is formed of one of a Ta layer, TaN layer, Ti layer, TiN layer, and a bilayer of these material layers.

9. (Amended) The metal interconnect [layer] structure of claim 2, wherein the conductive layer is formed of one of a Cu and a W layer.

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